v2.6 RTMA/URMA and Rapid Update RTMA Implementation Briefing

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June 26th, 2017

Quick update on “Good enough” items

Task Tracking Document Here

Developed in consultation with EMC management

This goes over the issues described by the ‘RTMA Good Enough Group’ led by Dave Bernhardt et al.

Entries worked on in v2.6 and/or upcoming implementations in support of RTMA:

Item 2e: Relaxation of gross error check tolerances to allow use of more observations

Item 2b: Simplified updating of reject lists through Obs Processing change: expanded to include mesonets

Awaiting NCO implementation of RFC to get into production (see back-up slides)

Entries worked on (and still being worked on) and anticipated for v2.7:

Item 3a/d: Much expanded ability for different weighting for different observations in varied situations.

Addressing via significant development effort on background error to include regime-dependence, thus fitting data more closely (see back-up slides)

May extend to item 4: improving the estimate of the analysis uncertainty

Item 3b: Inclusion of mesonet provider dependent errors

v2.6 Bundle: Timeline

Note* This is the first RTMA/URMA upgrade under the new procedures, means the evaluation occurs before hand off to NCO for their 30 IT day test

EMC devs conduct and run all pre-implementation testing.

Need to have continued discussions with user community to consider other ways to facilitate evals (e.g. retrospectives).

Implementation scheduled for October.

v2.6 Bundle: Contents + Outline

Rapid Update RTMA (15-minute cycle) - support AWC, HEMS, and aviation users

Hourly precip URMA for ConUS and Puerto Rico - support NBM

New terrain and land/sea mask in use for CONUS/PR/HI

- AK files to come in 2.7

New output fields:

- min/max RH product (URMA) - support NBM
- Significant wave height analysis (URMA) - support NBM and coastal WFOs
- AK: Ceiling - support aviation and NBM

v2.6 Bundle: Contents + Outline

- Relax QC criteria to increase use of mesonet temperature and moisture data
  - Assists with good enough item 2e
- New obs for URMA
  - Pseudo obs over Great Lakes via GLERL adjustment (long awaited item)
  - New data from UrbaNet and COOP
- Bug fix: Ceiling background from downscaled RAP/HRRR
- Reduce steepening in background error model along land/water boundaries based upon forecaster feedback

v2.6 Bundle: Rapid Update RTMA

RTMA system with updates every 15 minutes instead of every hour

Focus is aviation applications

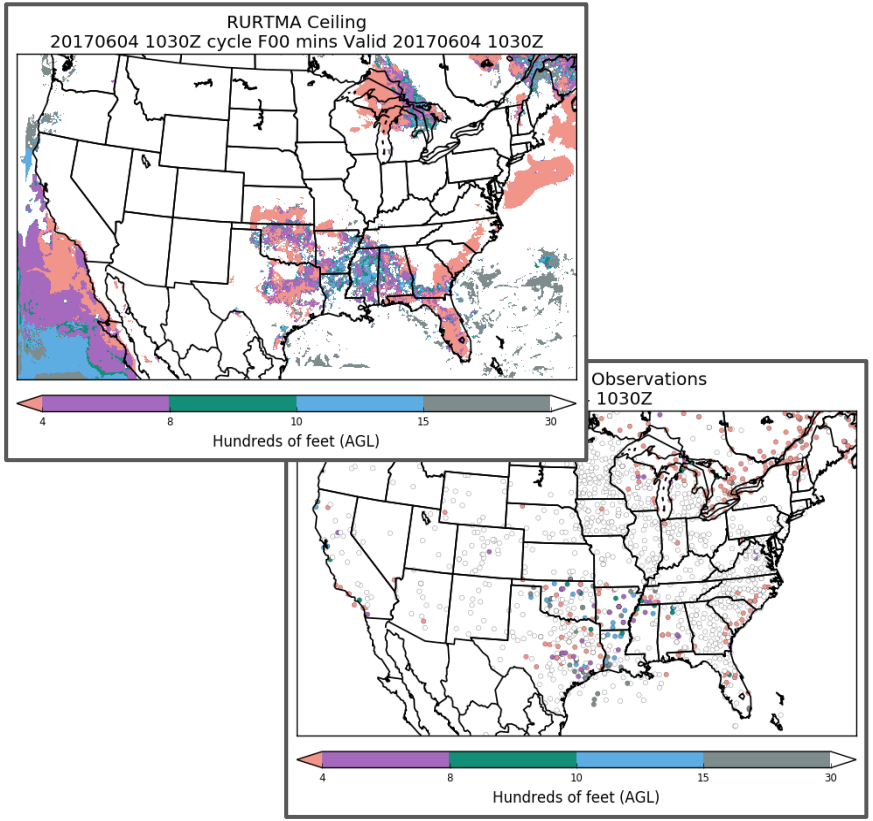
- Helicopter Emergency Med. Services tool
- Collaborative FAA AWRP project with AWC

Uses closest in time available data for C&V

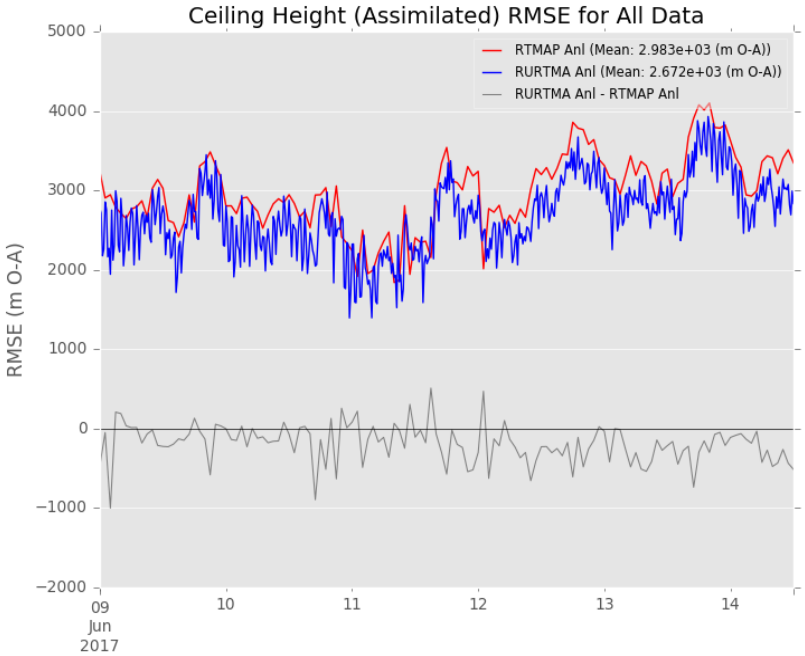
- No time interpolation among a window of observations
- Closer fit to data
- Uses 15 min output from HRRR

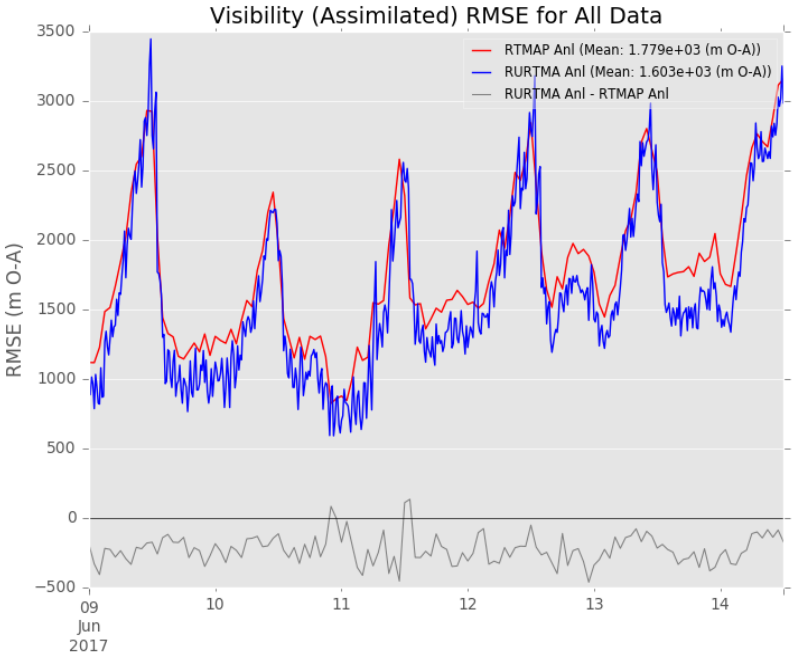
Available at T+20 mins.

- For v2.7, plan to go to T+15 mins.



v2.6 Bundle: Rapid Update RTMA

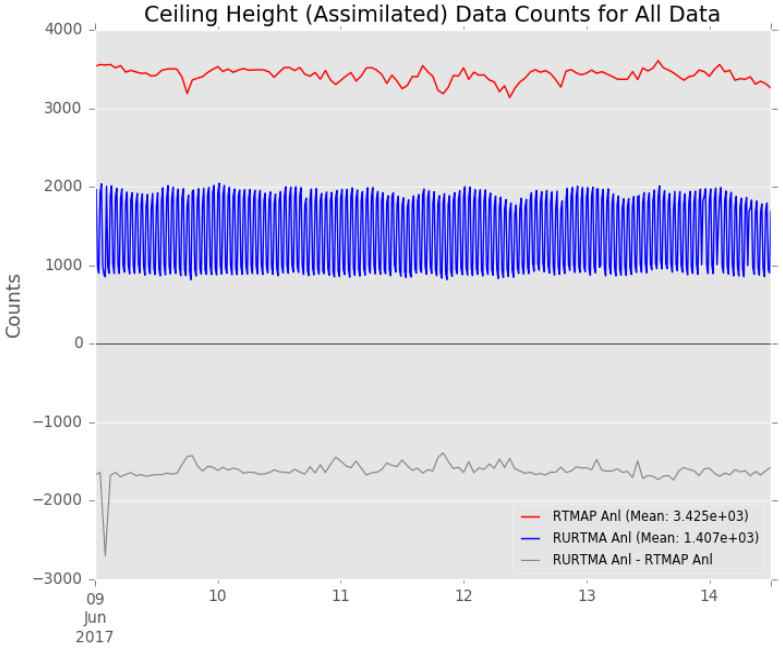


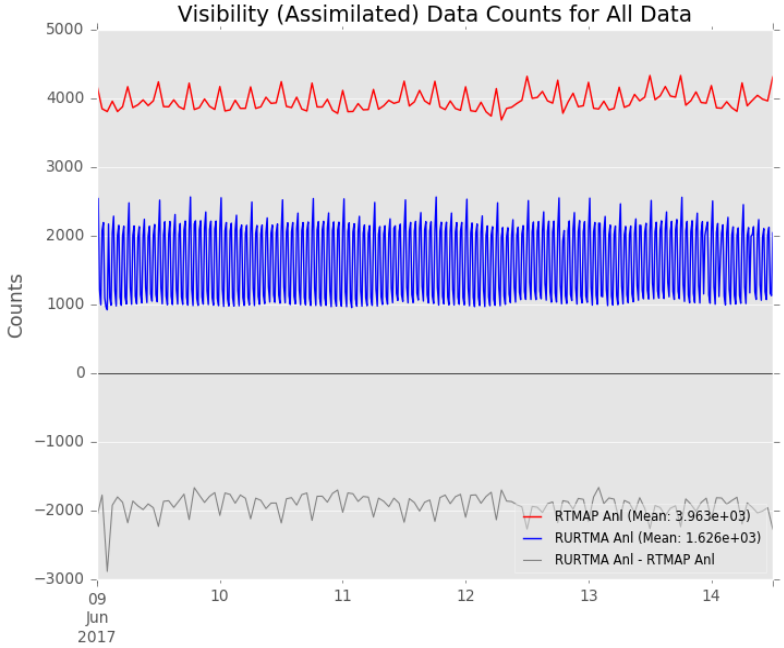


RURTMA (blue) fits ceiling and vis data more closely than hourly v2.6 RTMA (red)

- For C&V RU-RTMA only uses the observation closest to the analysis time

v2.6 Bundle: Rapid Update RTMA





RURTMA (blue) uses less data *per cycle* than hourly v2.6 RTMA (red)

- The number of assimilated obs for each 15-min window is less than hourly v2.6 RTMA.
- BUT the sum of assimilated obs in RURTMA in one hour is, on average, more than that in the hourly v2.6 RTMA

v2.6 Bundle: Precipitation URMA

Currently in operation: 6-hourly URMA for ConUS, Alaska and Puerto Rico (from hourly/6h RFC QPEs)

v2.6: add hourly ConUS and PR URMA - supports the NBM

PR: SERFC produces hourly and 6h QPEs for Puerto Rico

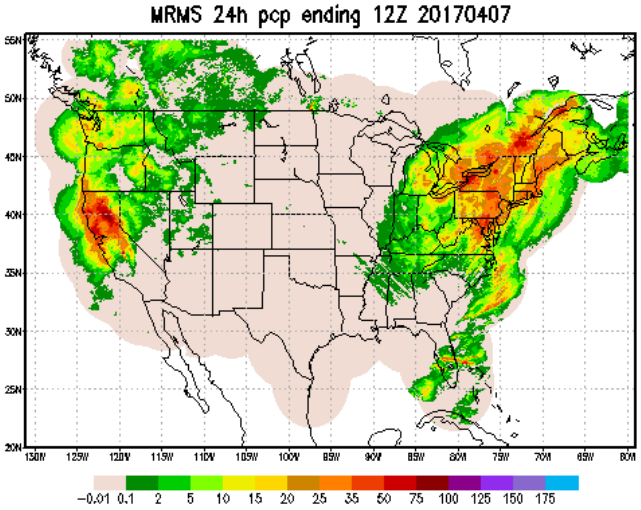
Issue for ConUS hourly: NWRFC and CNRFC only have 6h QPEs, the other 10 ConUS RFCs produce hourly QPEs. MRMS has hourly QPEs, but in the complex terrain out West the gauge-based RFC QPEs often has an advantage over the MRMS.

Solution: time-disaggregate 6h QPEs from NWRFC/CNRFC into hourly QPEs using hourly gauge-corrected MRMS as weights (if MRMS is missing or has zero precip in an area for the entire 6h, weight for each hour is assumed to be ⅙), and combine these with the hourly QPEs from the 10 other RFCs for a ConUS mosaic.

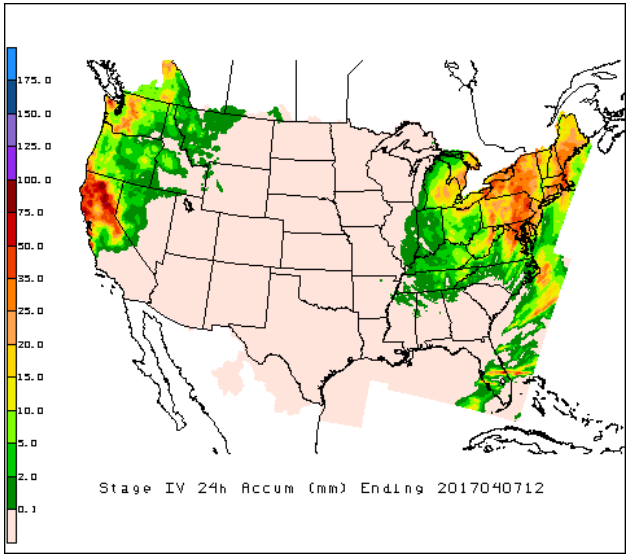
Kick off precip RTMA/URMA processing from pcpanl package (separate out precip RTMA/URMA from Stage II/IV processing)

v2.6 Bundle: Precipitation URMA

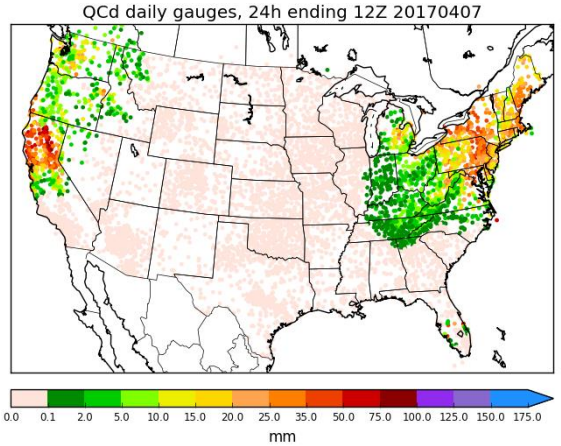
24h totals ending 12Z 7 Apr 2017



MRMS



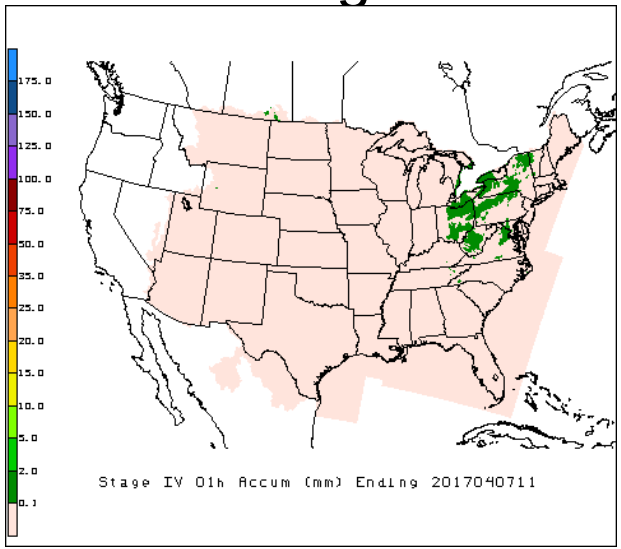
Stage IV

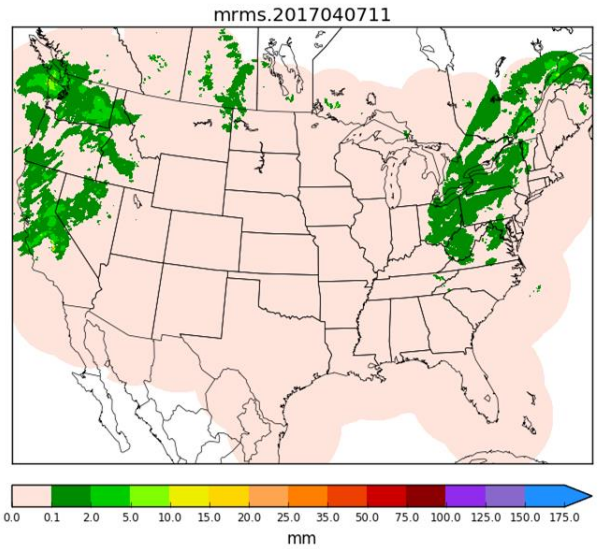


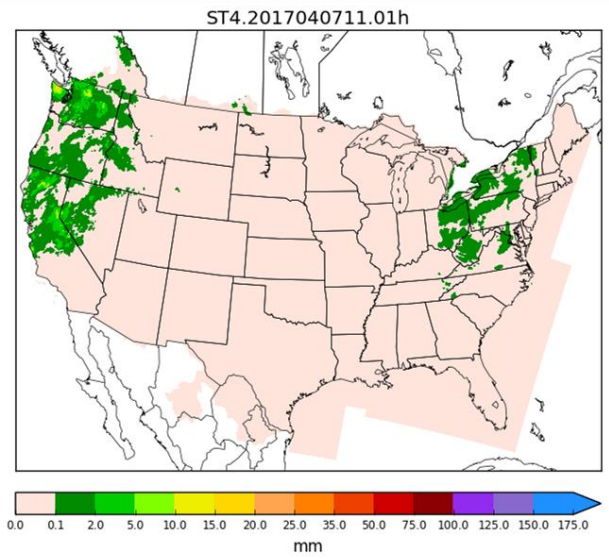
QC’d Daily Gauges

v2.6 Bundle: Precipitation URMA

1h ending 07Z 20140411







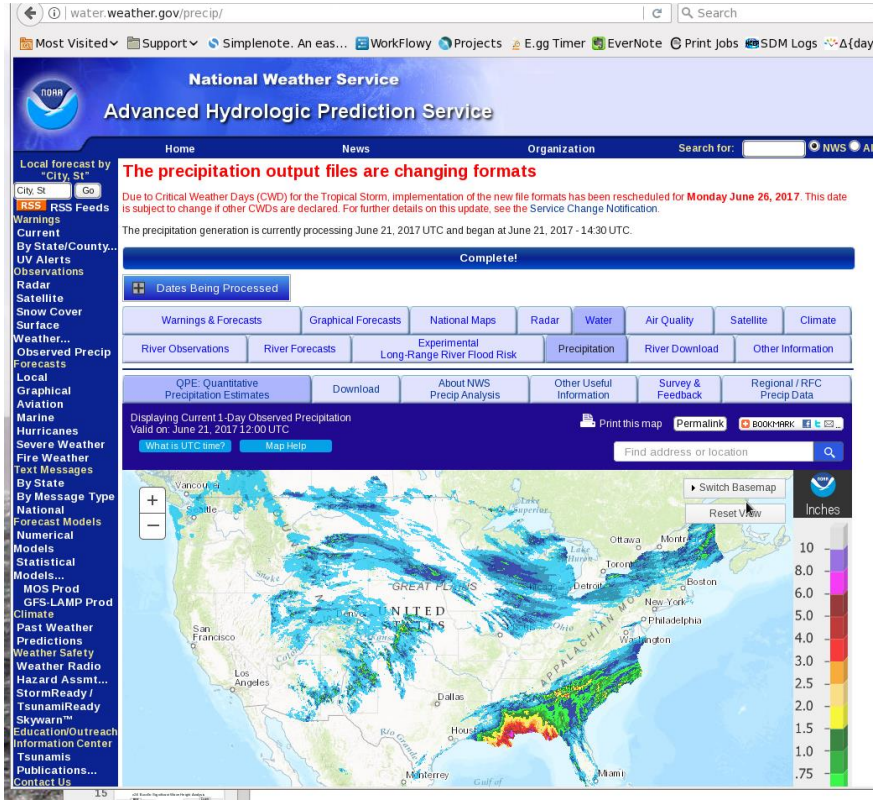
Current Hourly Stage IV (mosaic of RFC QPE): no coverage in NWRFC and CNRFC areas

Hourly MRMS

V2.6: hourly Stage IV/URMA

** Note: NWRFC/CNRFC have no offshore coverage
➔ Plan to fill in gaps with MRMS and/or satellite data in RTMA/URMA v2.7.

Stage IV to become source for water.weather.gov/precip

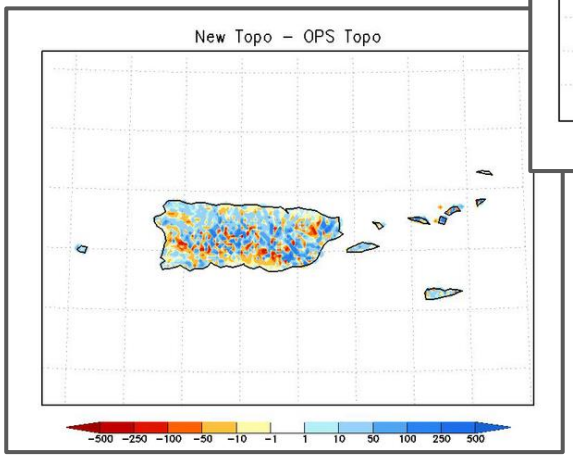


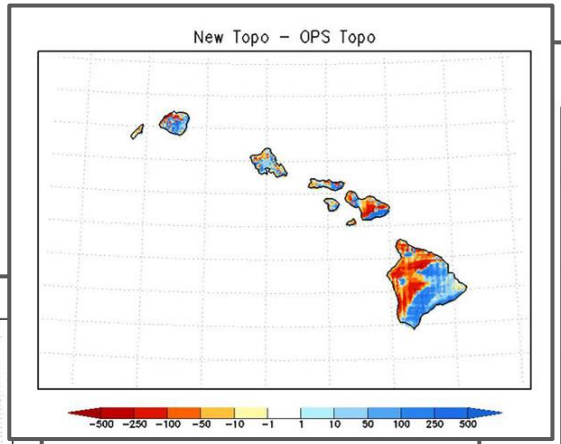
AHPS will switch to using NCEP Stage IV the week of 26 June (some minor changes in Stage IV processing for RTMA/URMA v2.5 was to accommodate its usage in water.weather.gov/precip)

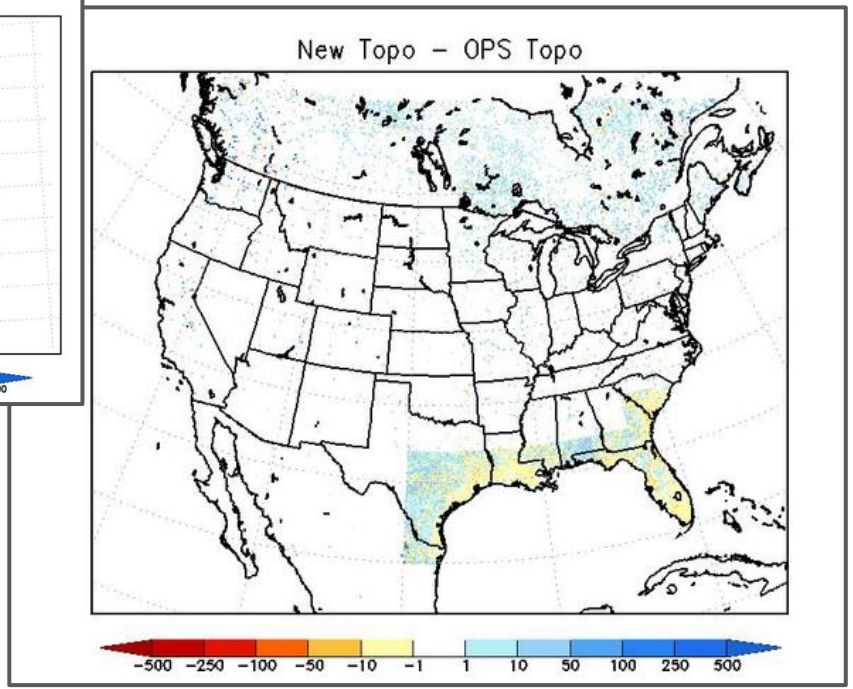
v2.6 Bundle: New terrain and land/sea mask

For CONUS/PR/HI

AK files to come in 2.7



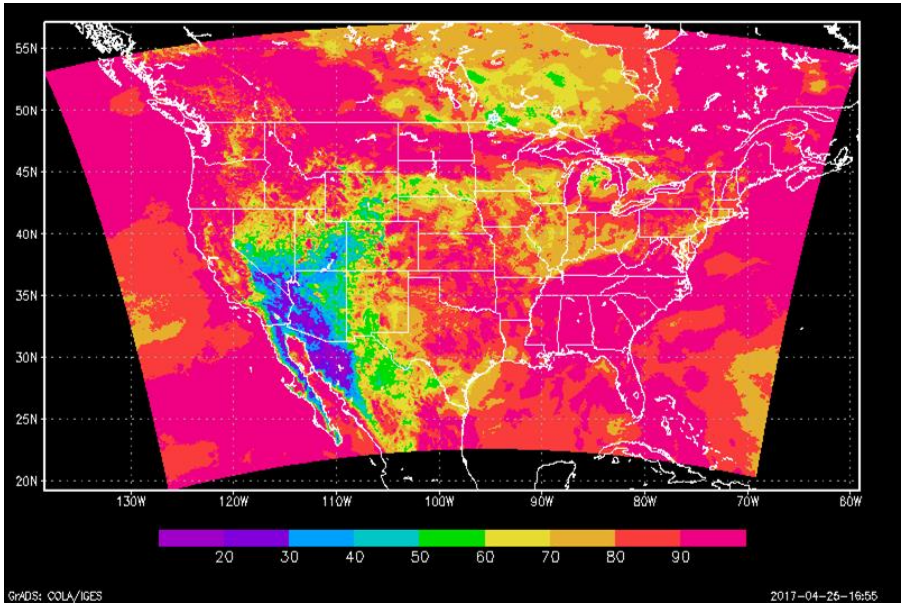




Thanks to Geoff Wagner, Brian Miretzky, George Gayno, WFOs, Regions, and others for all the help!

v2.6 Bundle: Min/Max RH

- Requested by NBM/MDL
- Maximum of hourly RH values from previous 12 hourly URMAs
  - RH derived from temperature and dew point analyses
- MaxRH: 06-18Z, minRH: 18-06Z
  - For CONUS, AK, HI and PR domains
  - No local time zone adjustment
  - Co-indices with min/max T analyses



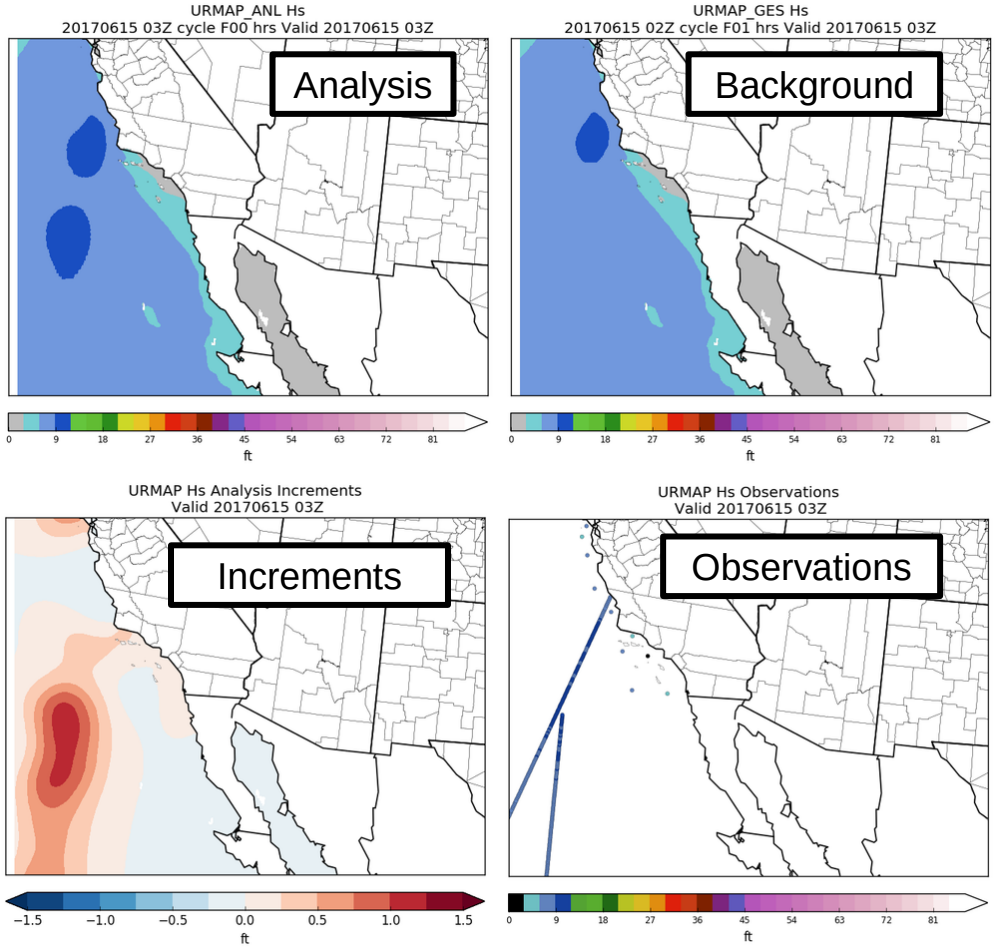
CONUS maxRH (%) valid 4/24/17

V2.6 Bundle: URMA Significant Wave Height

Background is from Global WW3

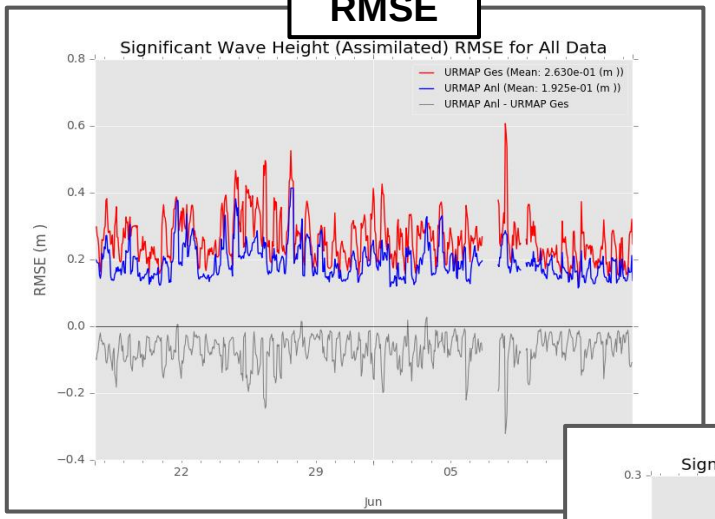
Assimilates buoy and satellite altimeter observations

- Satellite data:
  - ~650 Obs per hour
  - Jason-3, Saral/Altika and CryoSat-2
- In-situ buoy data:
  - ~60 obs per hour



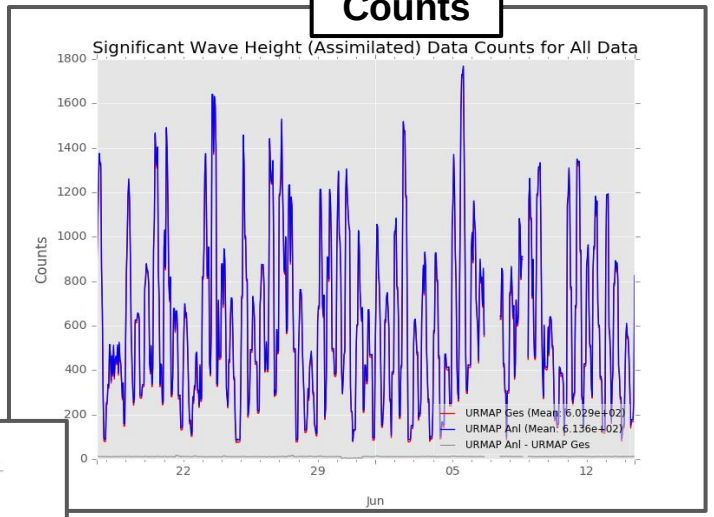
v2.6 Bundle: Significant Wave Height Analysis

RMSE

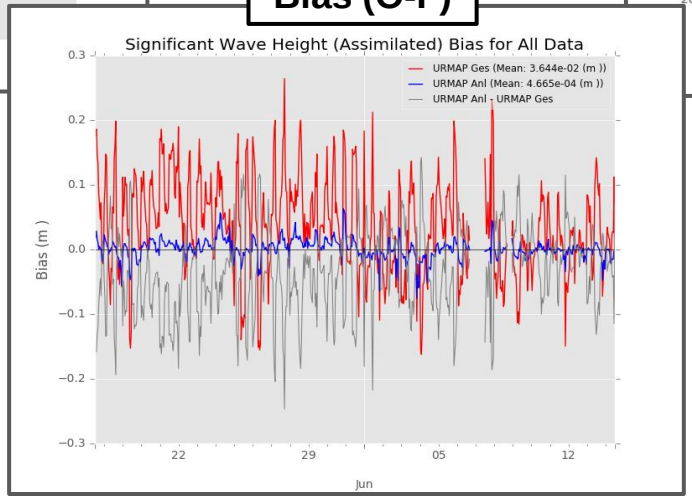


URMA Guess
URMA Analysis

Counts

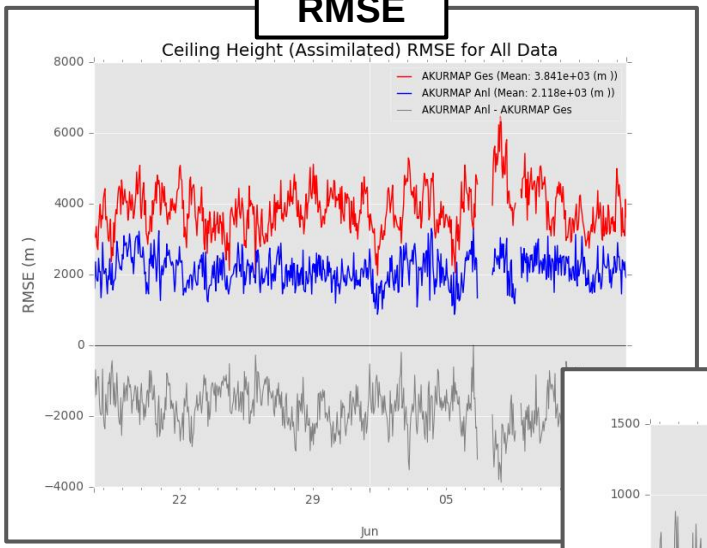


Bias (O-F)



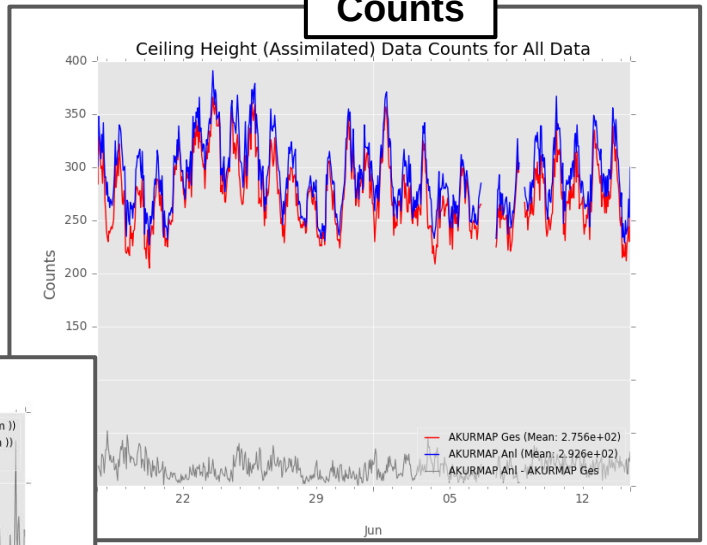
v2.6 Bundle: Adding ceiling to Alaska

RMSE

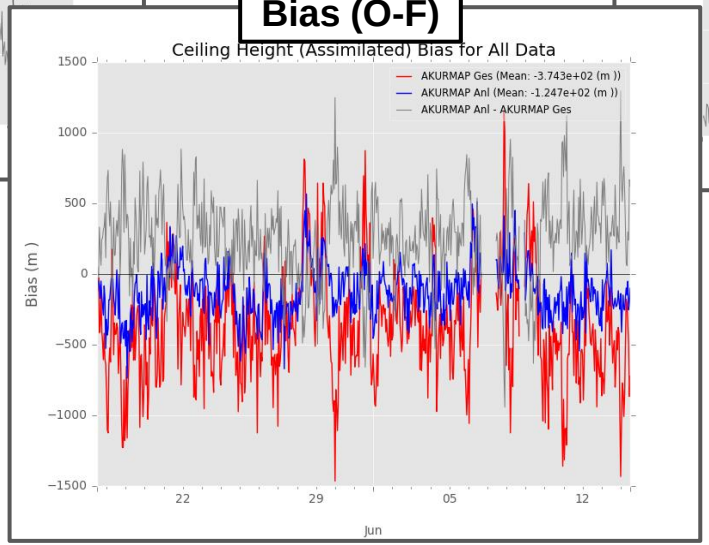


URMA Guess
URMA Analysis

Counts



Bias (O-F)



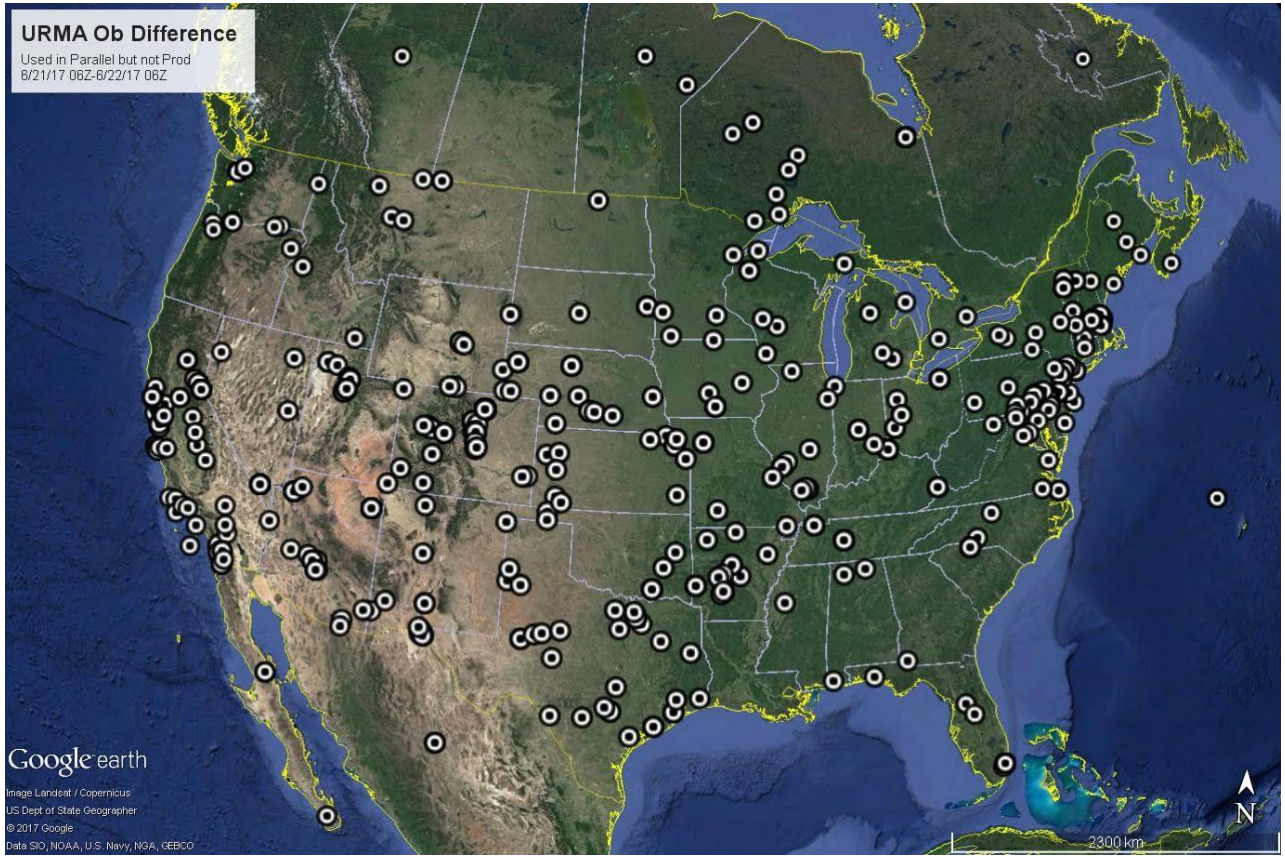
250-300 obs per analysis

v2.6: Relax Gross Error QC for Mesonet T and Q data

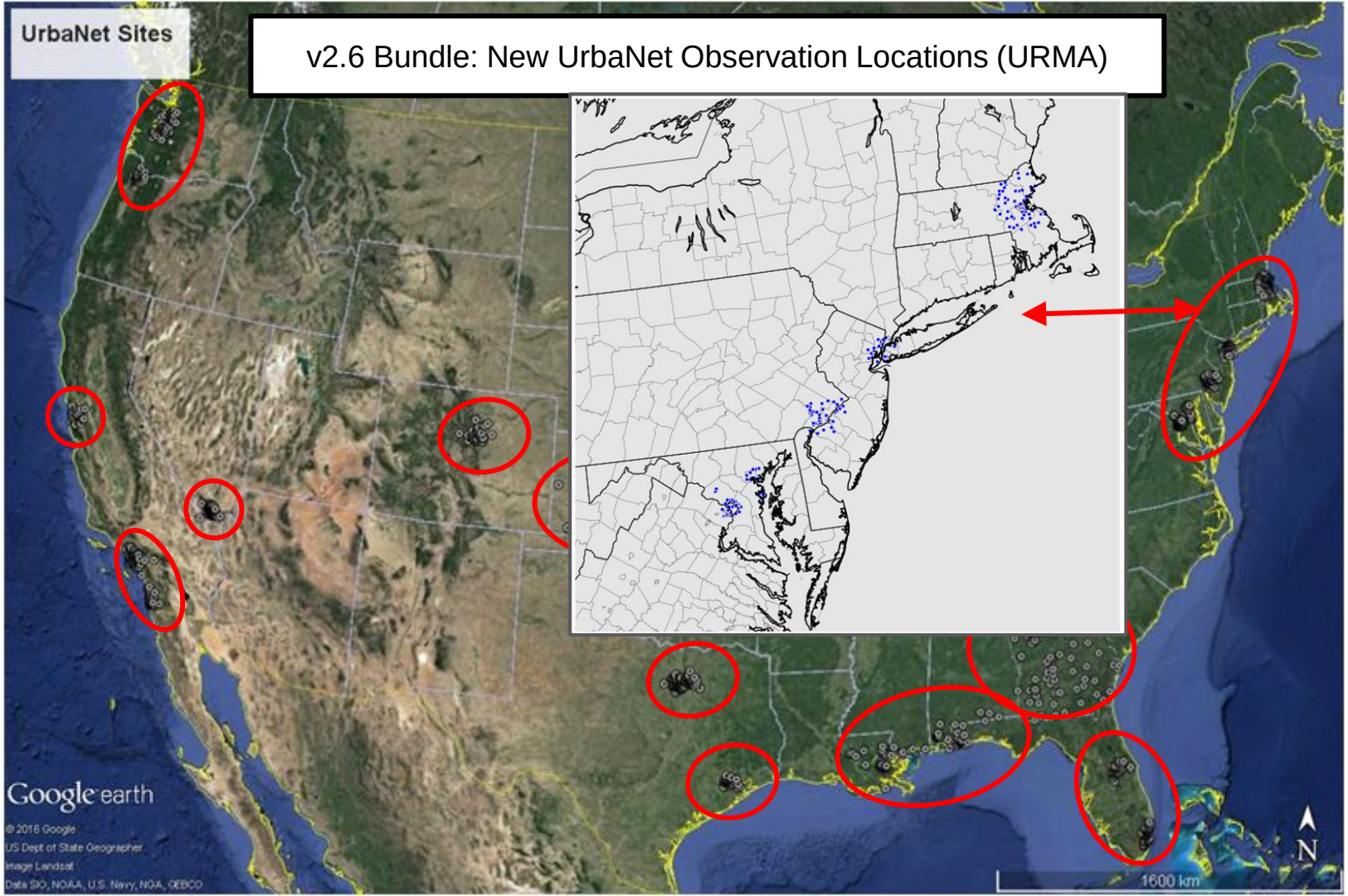
- Relaxed by 10%
  - Help address ‘Good Enough’ item 2e
  - Why?
    - During the iterative analysis procedure more mesonet T and Q observations would trickle in as the background adjusted to the analysis
    - Implies we are too strict with the gross error QC for these ob types
  - What does this mean?
    - We assimilate more observations
    - Those additional observations have a larger deviation from the background
      - As a result, bulk stats will show a slightly larger RMSE
  - For CONUS RTMA:
    - About 200-300 additional T and Q obs per analysis
    - Mostly stations with multiple reports
  - Applied to all domains

v2.6: Relax Gross Error QC for Mesonet T and Q data

Additional stations allowed in over a 24 hour period ending 06Z June 22, 2017



*Stations may have multiple reports/observations


UrbaNet Sites
v2.6 Bundle: New UrbaNet Observation Locations (URMA)
Google earth
© 2016 Google
US Dept of State Geographer
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
1600 km
N

v2.6: New data and relaxed gross error QC impacts

~11 thousand new T and Q obs per URMA analysis

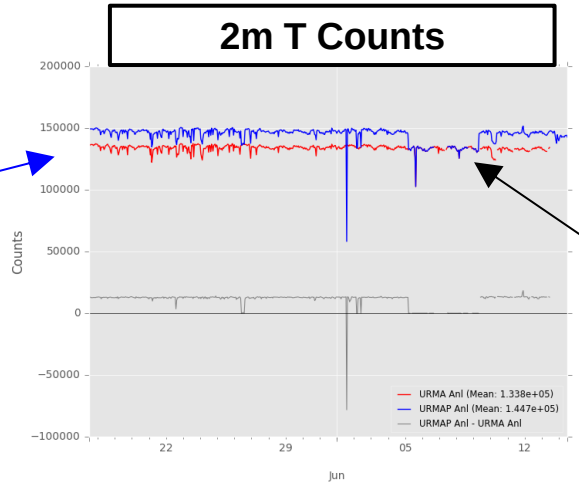
~ 5 thousand new wind obs per analysis

Very small increase in analysis RMSE due to relaxed gross error QC

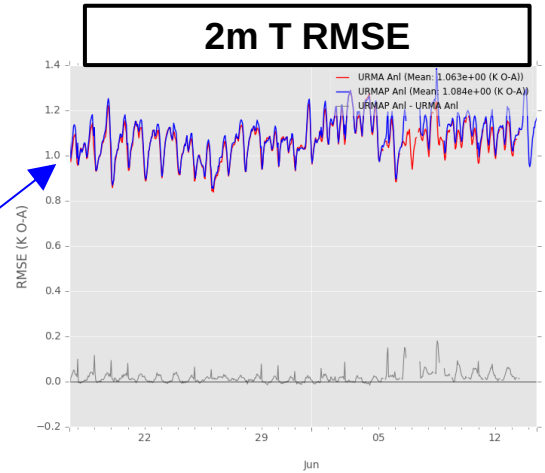
Larger O-Fs allowed into analysis translates to having larger O-As in the analysis

~0.02 K for T and and Min/Max T

~0.04 g/kg for specific humidity



WCOSS prod switches/downtime - used prod data



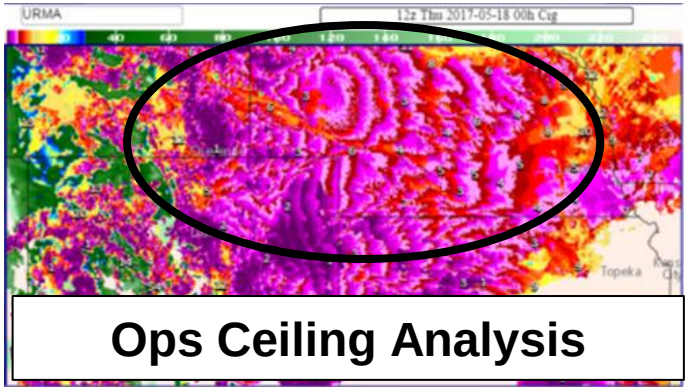
Ops URMA Analysis
v2.6 URMA Analysis

v2.6 Bundle: Bugfix for ceiling background

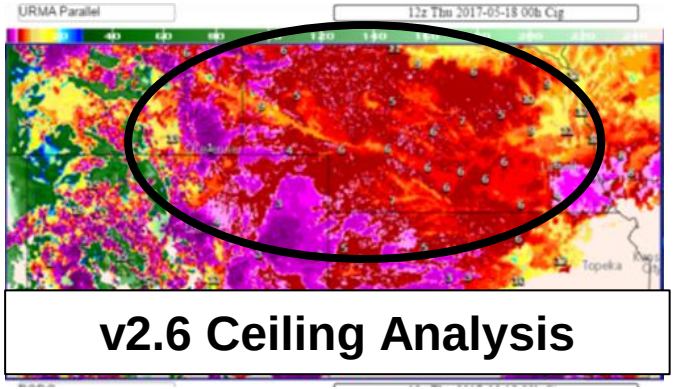
Bug fix in RAP/HRRR SmartInit code for Ceiling

GRIB2 Precision issue

Will be fixed in RAP/HRRR SmartInit implemented along with v2.6 RTMA/URMA upgrade



Ops Ceiling Analysis

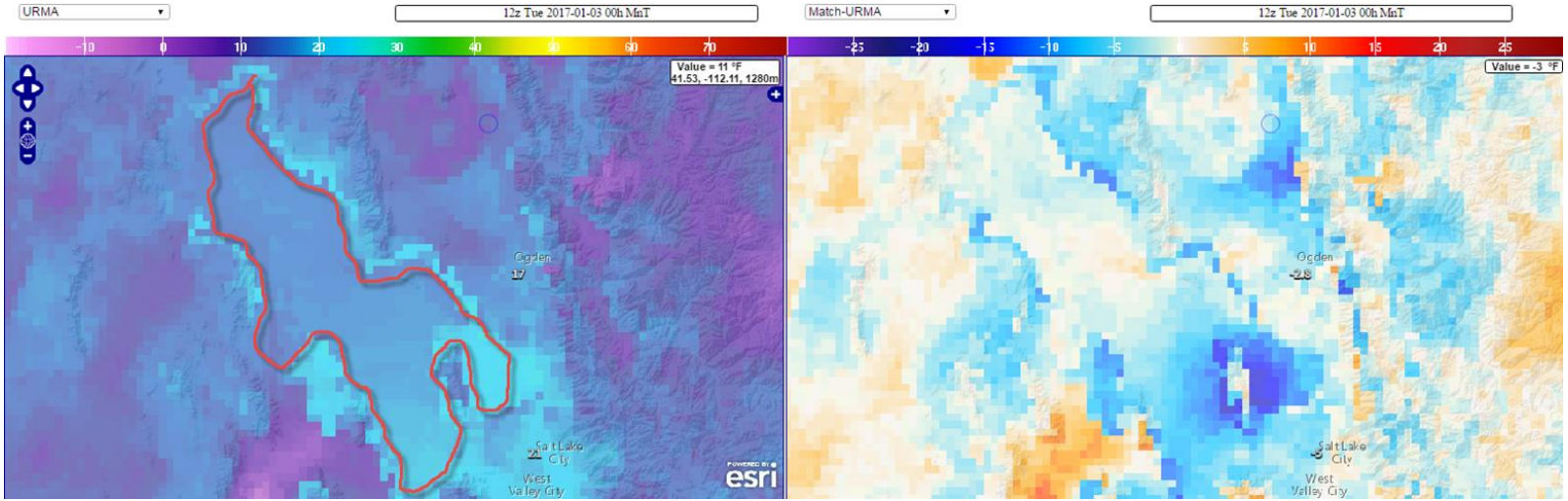


v2.6 Ceiling Analysis

V2.6 Bundle: Coastline background error change

Artifacts noted around Great Salt Lake (provided by Darren Van Cleave on Jan. 9)

Refresher:



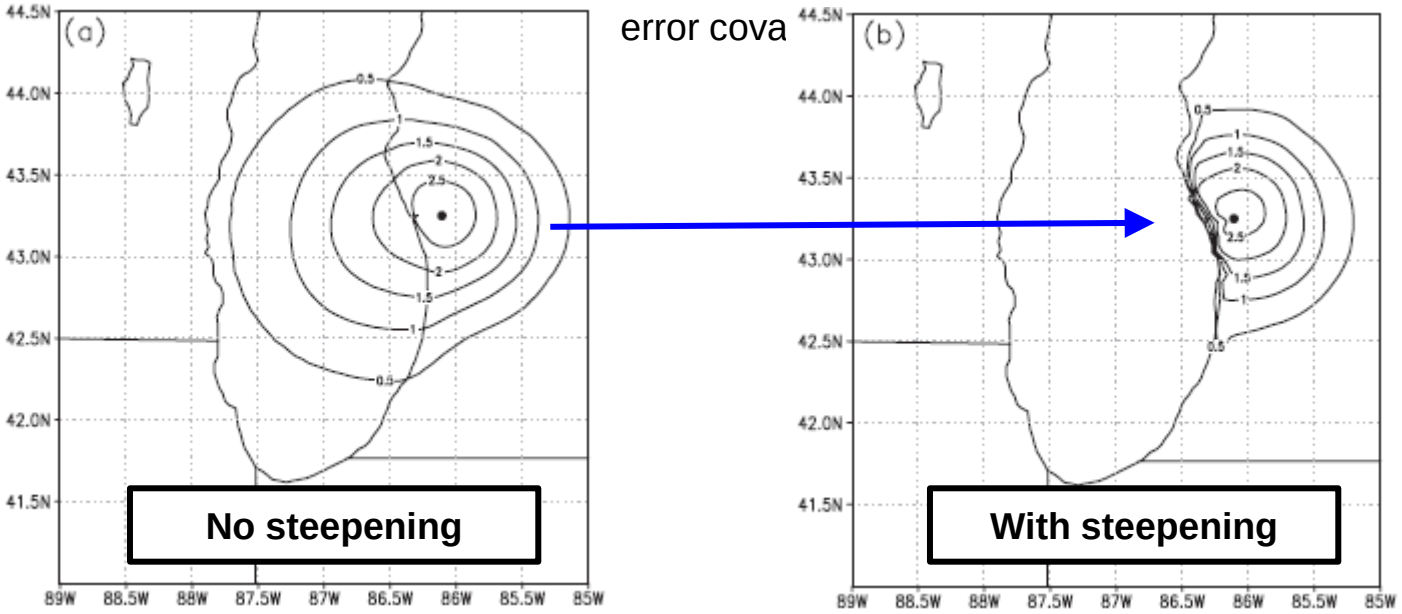
Initial impression: Likely a mismatch between terrain and land/sea mask data sets

After getting the terrain updates for v2.6 we re-checked the issue - but it remained!

v2.6 Bundle: Coastline background error change

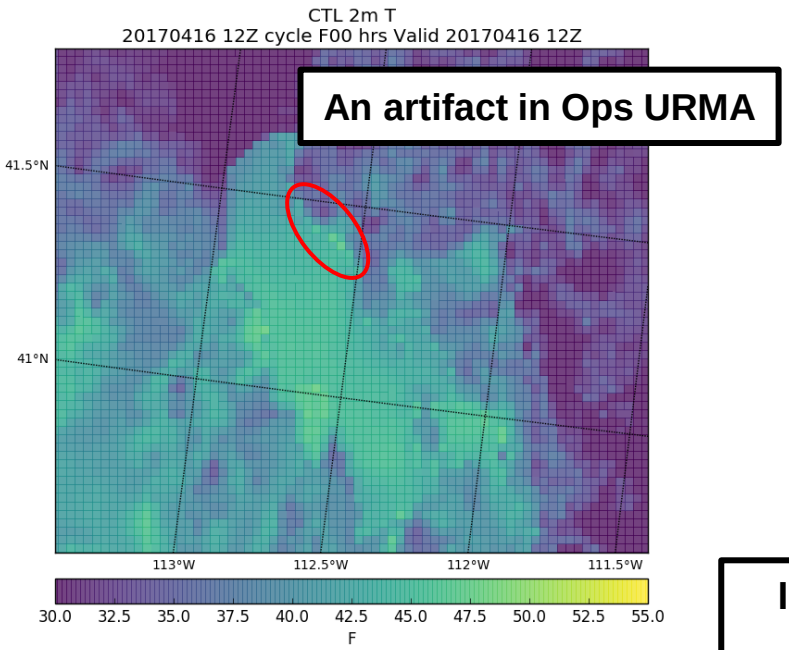
Further investigation revealed it is an issue with how we analyze temperature across water and land boundaries

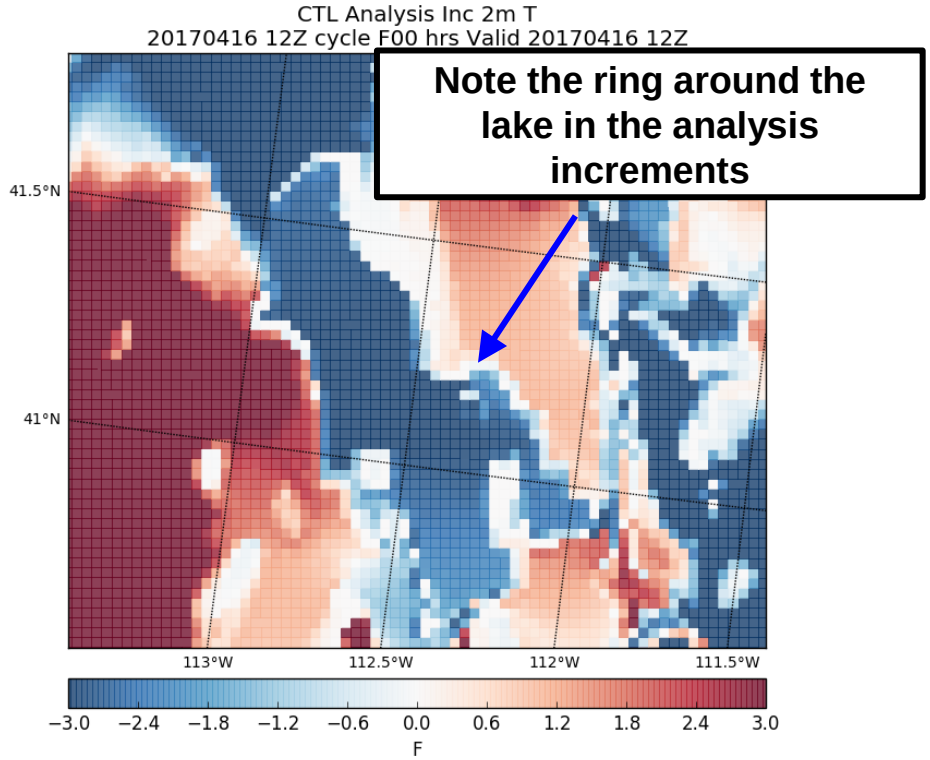
RTMA/URMA steepens the coastlines to retain land/water contrasts



v2.6 Bundle: Coastline background error change

This steepening is overdone and leading to artifacts

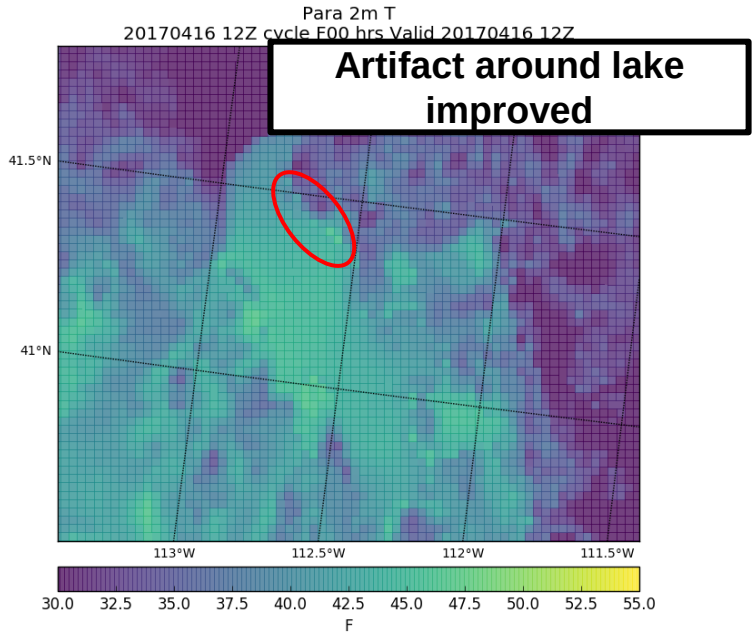


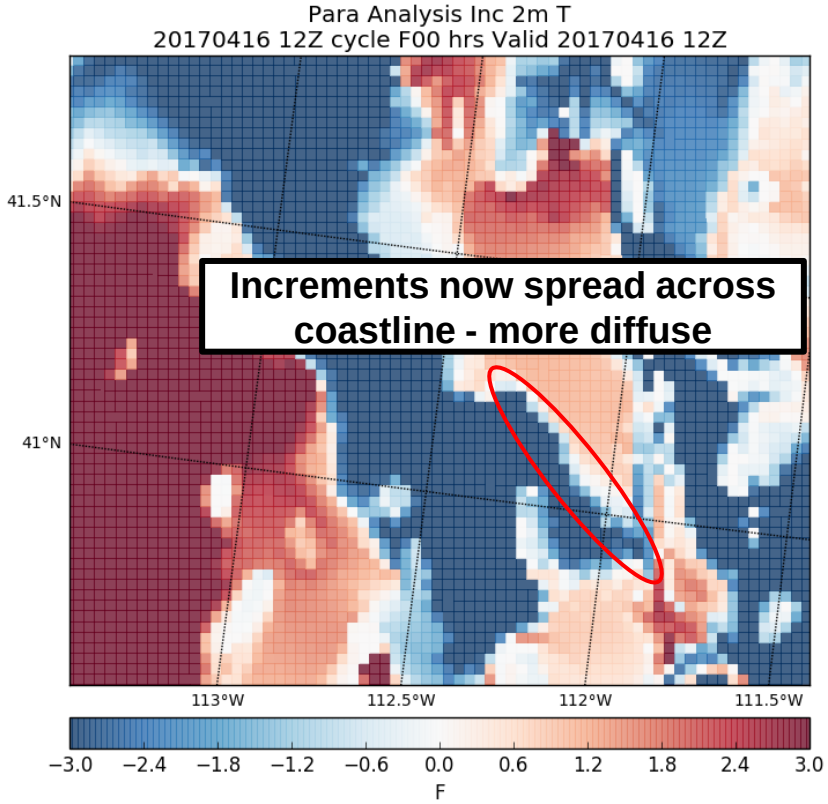


In this “ring” the background is not being updated - which leads to the artifacts

v2.6 Bundle: Coastline background error change

Solution is to reduce the steepening

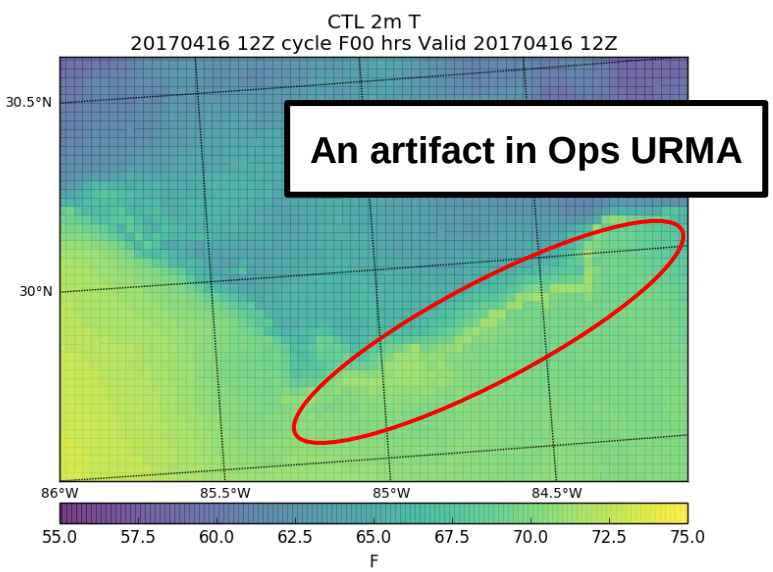


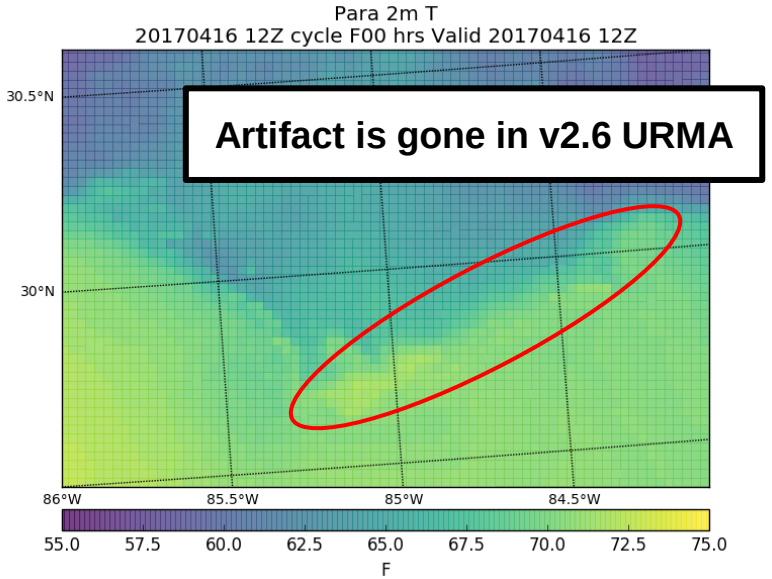


v2.6 Bundle: Coastline background error change

Further investigation showed RTMA/URMA had this issue around many coastlines.

Example: Central Florida Panhandle





Thanks to Darren Van Cleave for bringing this (tricky!) issue to our attention!

v2.6 Bundle: GLERL Method over Great Lakes

Goal: Create a smooth wind analysis over the Great Lakes that can be used to initialize Great Lakes Wave model

MMAB (Henrique Alves) suggested that URMA try to mimic analysis produced at GLERL.

Analysis relies on additional ‘adjusted’ observations.

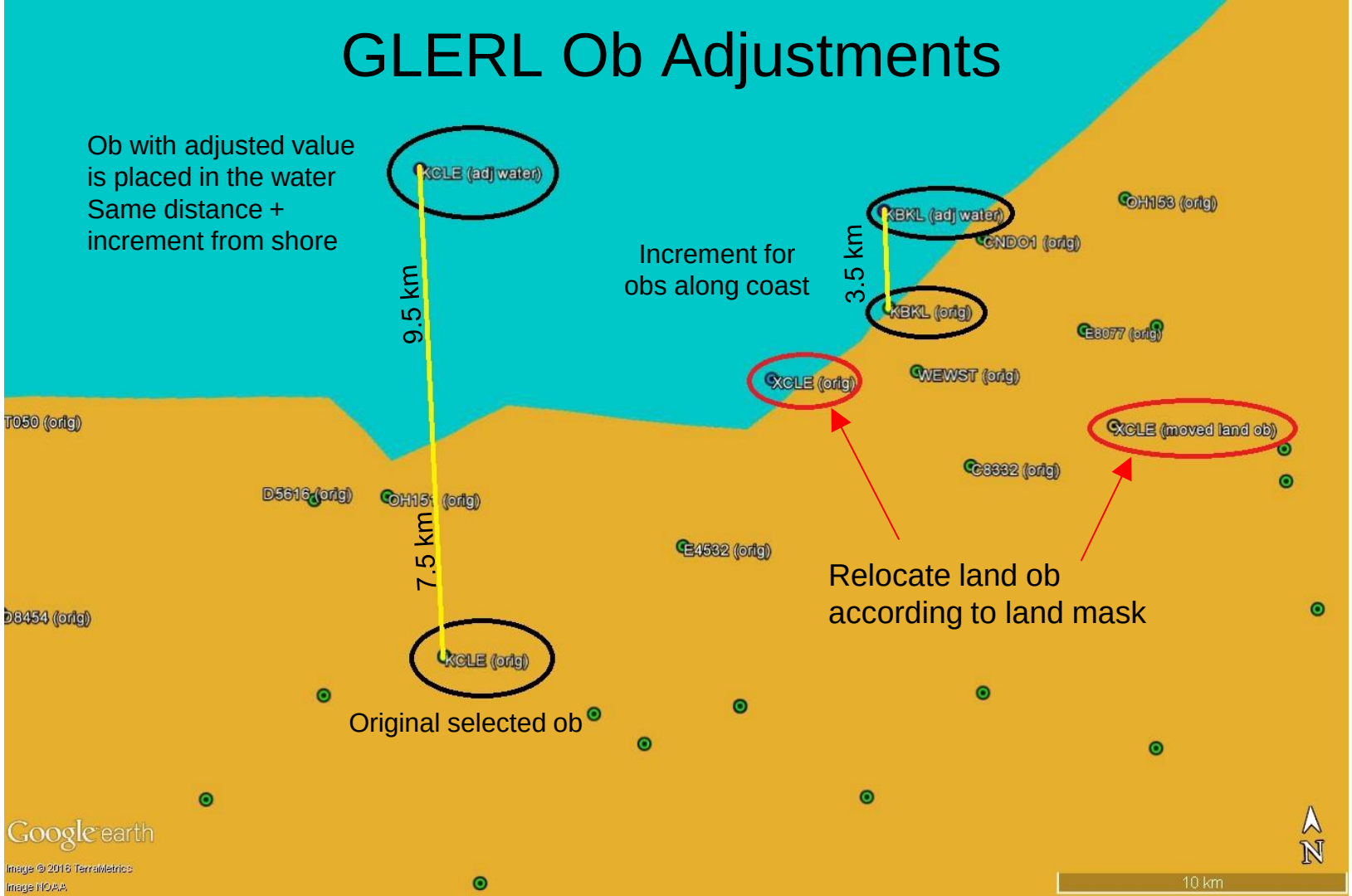
- Selected land-based sites used
- Formula developed at GLERL to adjust observations to represent over-water conditions
- Adjusted obs are then placed over the lake, terrain escarpment prevents cross-contamination
- Original ob remains at original site
- Additional ob sites were relocated so their location was consistent with land/sea mask

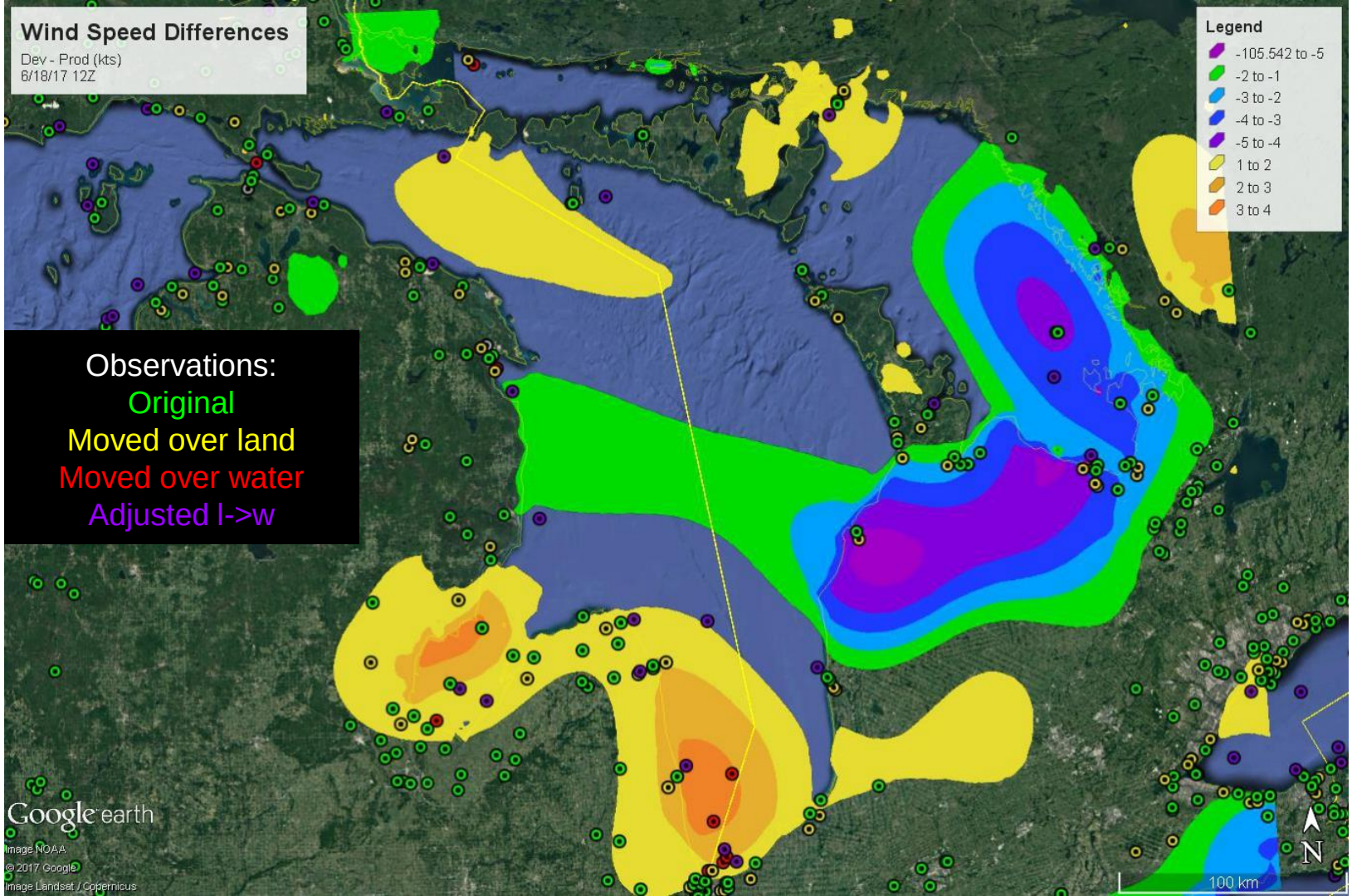
Adjustments are made in a new subroutine in observation file

- Due to runtime, process runs in URMA only

Increase correlation length scales for winds over Great Lakes by 50% for a smoother analysis

GLERL Ob Adjustments




Wind Speed Differences
Dev - Prod (kts)
6/18/17 12Z
Legend
-105.542 to -5
-2 to -1
-3 to -2
-4 to -3
-5 to -4
1 to 2
2 to 3
3 to 4
Observations:
Original
Moved over land
Moved over water
Adjusted l->w
Google earth
Image NOAA
© 2017 Google
Image Landsat / Copernicus
100 km
N

Evaluations - Part 1

MDL: Recommends implementation : New wave height and min/max RH helpful for NBM ; Hourly precip is helpful for the blend

Alaska Region: Recommends implementation : Will continue evaluating new ceiling height; New AK NAM nest is improving surface T

Southern Region: Recommends implementation ; Like the RU-RTMA, some forecasters have noted analyses improvements at and near the coast, URMA significant wave height will help with verification and validation of some marine forecasts, hourly precipitation fields will provide beneficial record for post-event studies of excessive rainfall events.

Western Region: Wind and gusts have low bias ; Continue aggressive implementation schedule ; SLC: “happy with the fix for the issue of "rings" around lakes, namely the Great Salt Lake. We're looking forward to having that fix in the operational version in September.”

Evaluations - Part 2

Eastern Region: Recommends implementation :

RU-RTMA not yet beneficial until dissemination to WFOs is addressed (data is available on ftp)

Great Lakes

Wind: seems a bit better, but difficult to tell.

Temp: parallel is warmer, potentially degraded (coastline steepening change?)

[EMC also addressed a bug in the GLERL temp adjustment that would cause warm temps]

Dissemination issues during eval

Hourly precip is helpful and new terrain may be improving analysis

OPC: Provided informal feedback - No recommendation

Prefer more extensive coverage of the wave height analysis beyond CONUS

We do have OCONUS coverage planned for v2.8

Major, oceanic domain coverage is outside the current scope of RTMA/URMA

Would like an RTMA version of the wave height analysis

Investigating now, however observation latency may limit quality (~70 obs per analysis)

Evaluations - Part 3

AWC: Recommends implementation

Noted trouble with dev-machine related latency on RU-RTMA

“The addition of the 15-min RURTMA is critical for our users from an aviation perspective. This product is very consistent with the hourly product yet has greatly reduced latency.”

WPC: Recommends implementation

Mostly evaluated temperature and moisture

Temps over Great Lakes were sometimes 2-4 F warmer (coastline steepening change + GLERL obs)

FAA: Provided informal feedback and recommends implementation

Differences noticed in cloud amount and ceiling

Parallel had less restrictive ceilings and more gradual transition between flight categories

What's next? v2.7

Updated background error covariance - better fit to observations

Good enough item: 3

Significant change

May extend to analysis uncertainty (Good enough item 4)

Improve C&V analysis via changing the variable transformation approach in the analysis algorithm

Better fit to the observations

Update terrain and land/sea mask for AK

Introduce provider-specific observation errors

Good enough item 3b (also helps with item 2)

RU-RTMA latency to 15 mins

Fill gaps in precip analysis near CONUS coastlines
Expected start for evaluation parallel: Mid-October, 2017

Implementation in March, 2018.

Thanks! Questions about v2.6, future developments, etc.?:
rtma.feedback.vlab@noaa.gov

BACKUP SLIDES

Ahead to v2.7: Improving the Background Error Model

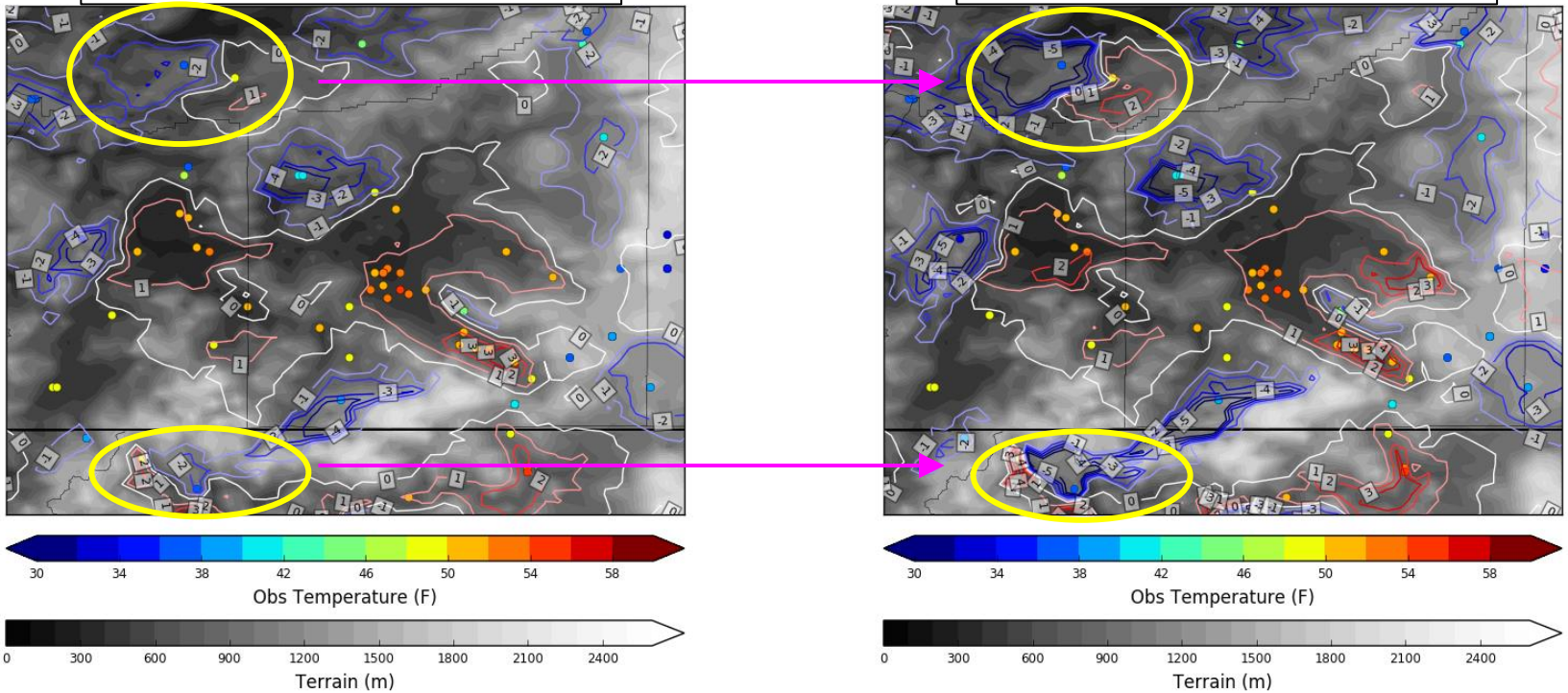
- Improved background error covariance model
  - Will fit data closer, **good enough item 3a/d**
  - Testing is in progress. Will broadcast a test parallel to the field as soon as possible.
  - When the background deviates considerably from an observation the analysis struggles to fit the observation well
    - Decreasing the observation error can help - but it’s not the observation that is in error
    - *Increasing* the background error will guide the analysis to fit the data more closely

Looking Ahead to v2.7: Updated background error

Medford, Oregon

Control: Temperature Analysis Increments

Experiment: Temperature Analysis Increments



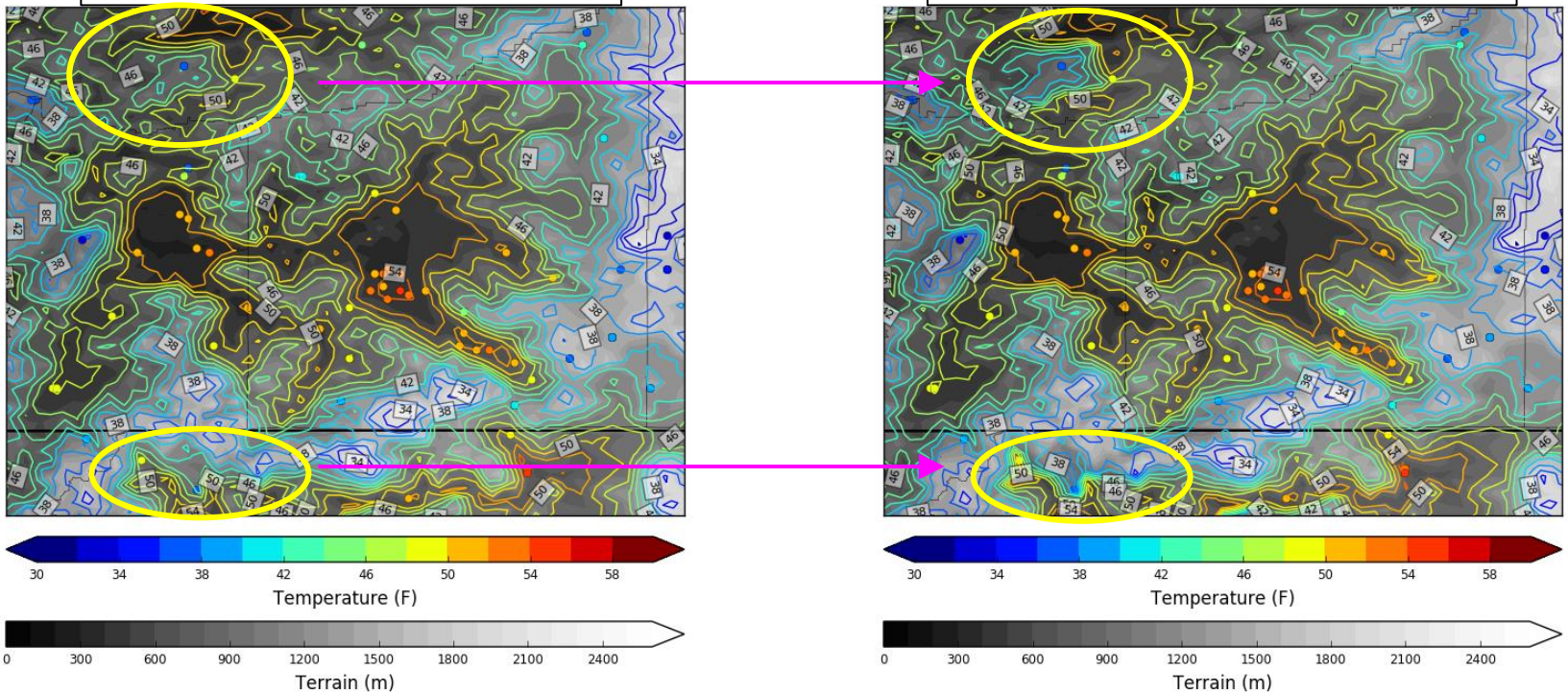
With updated background error covariance model EXP is able to more closely fit the observations

Looking Ahead to v2.7: Updated background error

Medford, Oregon

Control Temperature Analysis

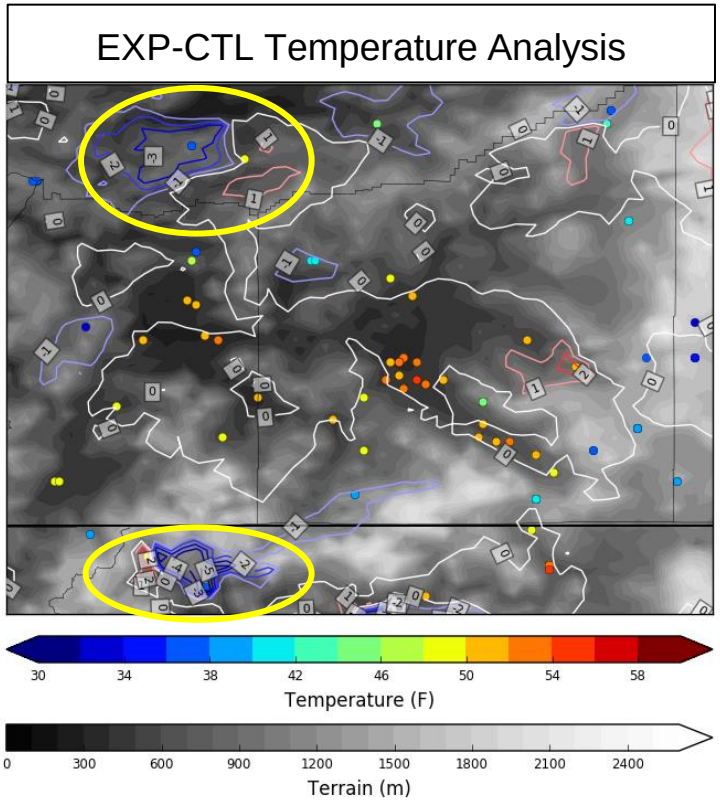
Experiment Temperature Analysis



With updated background error covariance model EXP is able to more closely fit the observations

Looking Ahead to v2.7

- EXP shows closer fit to observations over CTL
- Current test revises the background error based upon terrain variability in a neighborhood of a gridpoint
- Expandable to the variability in the field of interest
    - May improve utility of estimate of analysis error by providing some flow-dependence
- More testing is needed - field input will be critical
    - e.g., valley cold pool case studies



Mesonet QC Enhancements

Enhanced QC requested in ‘good enough’ document (item 2B)

Meeting with stakeholders (interested WR SOOs and ERH) held in April

Created form that SOO/DOH/center can use to identify bad stations

- Finding was that SOOs and DOHs should control this, not individual forecasters.
- List of stations is entered on sharable spreadsheet for easy tracking
- Form also approved by NCO (Carissa Klemmer/Patrick O’Reilly)

We will investigate and flag via SDM’s desk as needed

Requires decoder RFC (BUFR table change to mesonets) to process SDM edit marks

Has been submitted but no date for implementation yet

Improving Data Latency

Max Possible Additional Obs From Updating Tanks Every Minute vs. Two Minutes (current)